

Artículos

Spatiotemporal variability of horsefly abundance and richness in northwestern Patagonia

Variabilidad espaciotemporal de abundancia y riqueza de tábanos en el noroeste de la Patagonia

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Abstract: Horseflies (Diptera: Tabanidae) are a nuisance to humans and livestock in many regions around the world including Patagonia, Argentina. Although in this region there are no records of Tabanidae species as vectors of disease-causing microorganisms to livestock, it is suspected that they are disease vectors in other Argentinean regions adjacent to Patagonia. There are several studies on the taxonomy and morphology of Tabanidae in Patagonia, but little is known on their ecology and behavior in this region. An initial assessment was conducted aimed at describing the fluctuations in horsefly populations/activity throughout the flight season and among different locations in northwestern Patagonia using Nzi traps. Four species were captured throughout the sampling season totalling 483 individuals and most individuals (87 %) belonged to the species *Dasybasis antilope* Brèthes. Species phenology, abundance and composition were strongly influenced by site characteristics (e.g. vegetation, livestock) and less clearly by ambient temperature. The current study is an initial contribution toward understanding spatiotemporal fluctuations in horsefly populations and activity in the Argentinean Patagonia.

Keywords: *Dasybasis antilope*, Nzi trap, *Scaptia australis*, Tabanidae.

Resumen: Los tábanos (Diptera: Tabanidae) son una molestia para los humanos y el ganado en muchas regiones del mundo, incluida la Patagonia Argentina. Aunque en esta región no hay registros de especies de Tabanidae como vectores de microorganismos patógenos al ganado, se sospecha que éstos son vectores de enfermedades en otras regiones argentinas adyacentes a la Patagonia. Existen varios estudios sobre la taxonomía y morfología de Tabanidae en la Patagonia, pero poco se sabe sobre su ecología y comportamiento en esta región. Se realizó una evaluación inicial destinada a describir las fluctuaciones en las poblaciones/actividad de tábanos a lo largo de la temporada de vuelo y entre diferentes sitios en el noroeste de la Patagonia utilizando trampas Nzi. Se capturaron cuatro especies a lo largo de la temporada de muestreo con un total de 483 individuos. La mayoría de los individuos (87 %) pertenecían a la especie *Dasybasis antilope* Brèthes. La fenología, abundancia y composición de las especies estuvieron fuertemente influenciadas por las características del sitio (e.g. vegetación, ganado) y menos claramente por la temperatura ambiente. El presente estudio es una contribución inicial hacia la comprensión de las fluctuaciones espaciotemporales en las poblaciones y la actividad de tábanos en la Patagonia Argentina.

Palabras clave: *Dasybasis antilope*, *Scaptia australis*, Tabanidae, Trampa Nzi.

INTRODUCTION

Horseflies (Diptera: Tabanidae) are a nuisance to humans and livestock in many regions around the world including Patagonia, Argentina. This is due to the blood-feeding habit of female horseflies, which generally need protein to produce eggs. Adult horseflies of several native species are remarkably abundant from late spring to early summer across a variety of environments in northwestern Patagonia, from the arid steppe towards the east, to the humid rainforests in the western portion of the Andes. In some locations, a large number of horseflies can be simultaneously swarming on a single person or a large animal such as a cow or a horse (Coscarón, 1998). In the Patagonian-Andean region, where tourism represents one of the most important economic activities, tabanids are viewed as a pest by the general public due to the disruption of outdoor activities (Coscarón & González, 1989; Coscarón, 1998). Although in Patagonia there are no records of Tabanidae species as vectors of disease-causing microorganisms to livestock, tabanids are known as suspected disease vectors (e.g., equine infectious anemia) in other Argentinean regions adjacent to Patagonia (De la Sota et al., 2005; Ricotti et al., 2016). On the other hand, several species of Tabanidae in Patagonia have significant ecological roles. For instance, some species feed on the nectar of native plant species potentially pollinating many of them (Lessard, 2014) and larvae of most species are important predators of soil and aquatic invertebrates (Coscarón, 1998; Massaferrero et al., 2011). Lastly, larvae of some abundant species constitute food sources for other animals including invasive species such as the wild boar (Skewes et al., 2007). Thus, due to their high abundance, pest status and ecological roles, horseflies are a key component of the entomological fauna of the region.

Most research on horseflies in Patagonia has been conducted specifically on their taxonomy, morphology, and broad geographic distribution (Coscarón, 1998) but little is known on the ecology and behavior of Tabanidae in this particular region. There are several comprehensive studies and revisions on the taxonomy of horseflies that include species in Patagonia, which also provide information on the geographic distribution of some species (Wilkerson & Coscarón, 1984; Coscarón, 1985; González, 1999, 2017; Lessard, 2014; González et al., 2022). In the patagonian region in Argentina there are over 40 described Tabanidae species, most of which belong to the *Dasybasis* Macquart genus (Coscarón, 1998; Massaferrero et al., 2011), with some of the species being very abundant. The tribe Scionini also contains some common species, which can be a nuisance to humans and livestock in the shrublands and western humid rainforests. For instance *Oscia lata* Guérin-Méneville (syn. *Scaptia lata*) is known to

feed on humans and animals and is highly abundant in the Valdivian rainforest (Coscarón & González, 1989).

Despite these important contributions to the knowledge of Tabanidae, studies in Patagonia assessing population dynamics, the ecology and behavioral aspects of horseflies are surprisingly scarce. Additionally, basic information, such as relative species abundance, habitat preference, phenology and feeding habits is lacking. Information on habitat preference is mostly based on opportunistic observations and locations of the collected specimens in museum collections but there is no systematic specimen sampling associated with habitat types. Documenting community composition and abundance fluctuations of adult horsefly populations over the flying period in relation to temperature variations and site characteristics is necessary to better understand the environmental requirements of the most common tabanid species.

The objective of this study is to know species richness and abundance of Tabanidae over three months, from late spring to mid-summer in northwestern Patagonia, Argentina, to qualitatively evaluate their spatial and temporal variability. Our intention is to conduct an initial assessment aimed at describing the fluctuations in horsefly populations throughout the flight period and among different locations, and associate these with temperature and relative air humidity fluctuations and among different sites with diverse vegetation and presence/absence of livestock.

MATERIALS AND METHODS

Study area

The study was conducted in Nahuel Huapi National Park, in northwestern Patagonia during one flight period (mid-November 2014 to mid-February 2015). The sampling was carried out in five study sites located in mountain valleys and distributed at altitudes ranging from 820 to 930 masl. Sites were distributed along an approximately 18 km north-south transect with an average distance of 4.7 km between proximate sites. The average annual rainfall in the region is approximately 1800 mm (Barros et al., 1983) and the mean annual temperature is approximately 12 °C. Depending on the study site, vegetation consisted of tall forests (30 to 35 m) of non-native pine trees or the native evergreen angiosperm, *Nothofagus dombeyi* (Mirb.) Ørst.; or 5 to 8 m tall shrublands of *N. antarctica* (G. Forst.) Oerst. and the bamboo *Chusquea culeou* Desv. with variable densities of vegetation cover. The sites ranged from open wetlands to forests with pastures to gaps within relatively dense tall shrublands (Table I). Baqueanos is an open sunny meadow and wetland (locally called “mallín”) with moderated livestock presence (horses) surrounded by sparse shrublands. Melgarejo is the relatively sunny edge of a house

yard that limits with a pine plantation on a sparsely populated area (within the National Park). Guillermo is a grassy gap within a shrubland composed of tall shrubs, bamboo, and short trees (less than 8 m tall). Seccional is the shady edge of the yard of a Park Ranger's house, which limits with the native tall southern beech (*N. dombeyi*) forest. Hotel is the grassy yard of an old hotel, which has been closed to the public for decades, and limits with the native tall southern beech forest. These sites were selected to encompass a variety of environments with contrasting vegetation physiognomy.

Table I. Location and characteristics of the five sampling sites.

Site	Latitude	Longitude	Elevation (m)	Vegetation	Livestock presence	Temperature ¹	Humidity ²
Baqueanos	41°14'39"S	71°27'43"W	817	Wetland	yes	14.7±0.15	54±0.4
Melgarejo	41°13'18"S	71°24'35"W	910	Pine plantation / house yard	no	14.9±0.18	61±0.3
Guillermo	41°21'19"S	71°30'09"W	929	<i>Nothofagus antarctica</i> & <i>Chusquea culeou</i> shrubland	no	12.3±0.15	61±0.4
Seccional	41°16'13"S	71°29'48"W	854	<i>N. dombeyi</i> forest	no	14.4±0.17	66±0.4
Hotel	41°19'37"S	71°29'53"W	837	House yard / <i>N. dombeyi</i> forest	no	14.1±0.2	71±0.4

Table I.

Location and characteristics of the five sampling sites.

¹ °C mean ± S.E. ² RH% mean ± S.E.

Tabanidae sampling

Tabanidae populations were monitored using Nzi traps (Mihok, 2002; Mihok et al., 2006) which are effective and relatively specific for biting flies. A Nzi trap is made of cloth and has a triangular layout, with a blue front, a black back, and a lower front entrance. The top is closed by a tetrahedron “cone” of white netting, and a plastic funnel inserted into a plastic jar on top as a collector. Sunbrella™ Pacific Blue and Black acrylic awning/marine fabric was used due to its resistance to weathering and reported attractiveness to horseflies (Mihok et al., 2006). Two Nzi traps per site at five different sites (10 traps total) were deployed, which were located within natural or anthropogenic vegetation gaps of at least 750 m². Traps were revised at weekly intervals during one tabanid flight period (i.e., Nov 2014 to Feb 2015; 13 weeks). Collected specimens were stored in a freezer at -18 °C until examined for classification and species identification. Horsefly specimens were classified into morphospecies and then sent for identification to the specialist in the taxonomy of Tabanidae, the late Dr. S. Coscarón, who worked at the University of La Plata, Argentina. Species richness and abundance per site and for all sites together were computed, as well as weekly abundance per site.

Hourly air temperature and relative air humidity (RH) were measured with data loggers on each site (Hygrochron iButton DS1923, Maxim Integrated), at 1.0-1.5 m above the ground. Data loggers were covered with a small protective roof away from direct

sunlight and were active in the field for 84 days in all sites simultaneously (i.e., November 20, 2014 to February 11, 2015). For each trap revision date/site, hourly temperature and humidity data were averaged contemplating the seven previous days to the revision date.

RESULTS

A total of 483 individuals of four species were captured throughout the sampling season. Most individuals (87 %) belonged to the species *Dasybasis antilope* Brèthes while 12 % to the species *Scaptia australis* Philippi, and the remaining 1 % to *D. gagatina* Philippi and *D. andicola* Philippi (Table II). The most abundant species (*D. antilope*) was captured in four of the five sites, although the capture was representative almost exclusively in one site (Baqueanos), whereas individuals of the second most abundant species (*S. australis*) were more evenly distributed among sites. There was a large variability in the number of captured horseflies among sites ranging from a total of 416 in Baqueanos (all *D. antilope*, except one individual) to two in Hotel. The site with the highest richness (i.e., Seccional; four spp.) was also one of the sites with the lowest abundance (nine individuals) together with Hotel, with only two individuals. Both, Melgarejo and Guillelmo had intermediate abundances mostly composed of *S. australis*, but in the warmest site (Melgarejo) the captures peaked in mid-December, whereas in the coolest site (Guillelmo) these peaked in early January.

Site	Tabanid species			Total abundance (and richness)
	<i>Dasybasis antilope</i>	<i>Scaptia australis</i>	<i>Dasybasis gagatina</i>	
Baqueanos	415	0	1	416 (2)
Melgarejo	1	29	0	30 (2)
Guillelmo	1	25	0	26 (2)
Seccional	5	2	1	9 (4)
Hotel	0	2	0	2 (1)
Total	422	58	2	483 (4)

Table II.

Tabanidae species captured in five sites in northwestern Patagonia, for three months 2014/2015/late Spring 2014 to middle Summer 2015.

Overall, variations in horsefly abundance weakly follow average temperature fluctuations during December and January (Fig. 1). However, after the drop in average temperatures of approximately 4 °C recorded in mid to late December (Dec 18 to Dec 26), captures decreased by nearly 70 % and recovered after two weeks following an increase in temperature (except in Melgarejo and Hotel). Despite this, in Baqueanos, there was also a similar decrease in captures by mid-January that was not associated with temperature drops. By early February, the abundance of horseflies captured decreased in Baqueanos, Guillelmo and Seccional (Fig. 1).

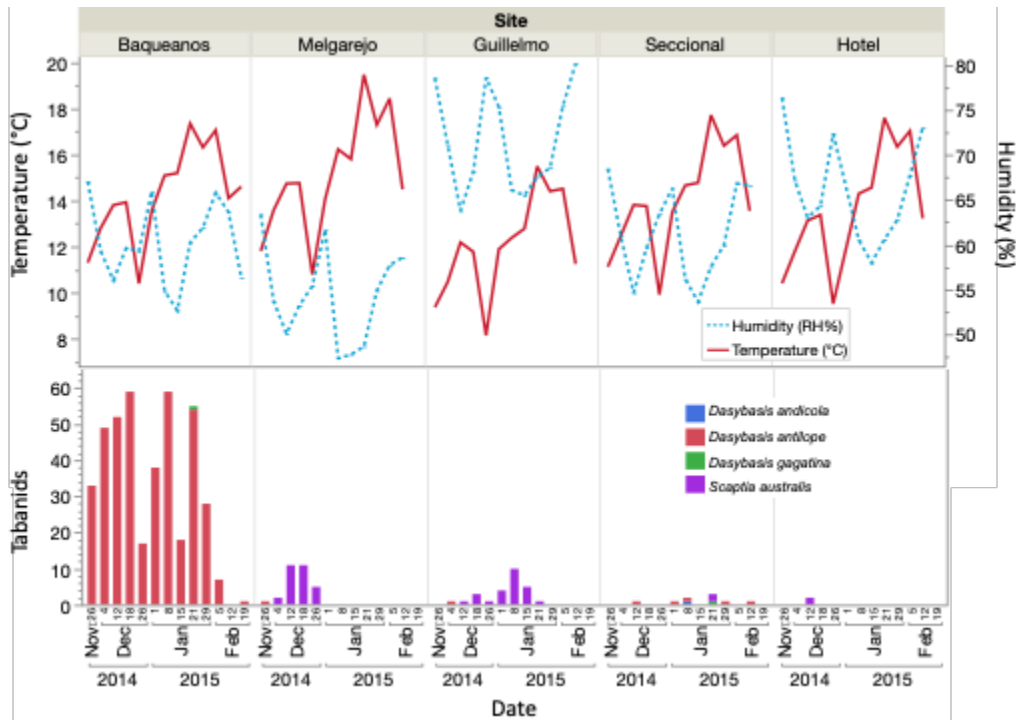


Figure 1.

Mean air temperature, mean relative humidity %, and total captured horseflies of four species during the trapping period across five different sites with contrasting characteristics in northwestern Patagonia.

Tabanid phenology, abundance and species composition seem to be influenced by site characteristics (Table I; Fig. 1) with temperature variability being another factor driving population numbers. Average recorded temperatures for all these sites are markedly different, with the most extreme difference being of 2.6 °C in overall average temperatures (12.3 vs. 14.9 °C, Table I), resulting in a shift of the moment when populations peak depending on site local temperatures. For instance, in the site with the highest temperatures (i.e., Melgarejo), captures peaked early, during mid-December 2014, while in the site with the lowest temperatures (i.e., Guillermo) captures peaked a few weeks later, in mid-January 2015 (Fig. 1). Nevertheless, one of the sites where temperatures were found to be moderate (i.e., Baqueanos) captures were relatively constant throughout the flight season (Fig. 1).

DISCUSSION

This is the first study that provides novel information on the relative abundance and composition of tabanids in northwestern Patagonia. Horsefly abundance and richness are highly variable among sites showing an enormous variation in horsefly abundance among relatively close environments. Overall recorded richness was

relatively low compared to the number of species cited for the entire patagonian region in Argentina (47 according to Coscarón, 1998). Although this study involves a modest sampling effort, it nevertheless constitutes a significant progress for the knowledge of the spatiotemporal variability of horseflies in the study area. Future studies should encompass a wider variety of environments during multiple sampling periods to better characterize the composition of a wider portion of the horsefly community in Patagonia.

Our results suggest an influence of site characteristics on the abundance and species composition of horseflies. Higher horsefly abundance of *Dasybasis antilope* in Baqueanos could be associated with several characteristics of the site. Livestock presence has been shown to be associated with increased horsefly abundance in certain areas, as large animals result more attractive from an olfactory and visual point of view to female horseflies (Baldacchino et al., 2013). In addition, the wetland is potentially a better location for larval development of this species. Despite that the preferred environment of *D. antilope* larvae has not been described in the literature, it is likely that wet soils are favored as it occurs with many Tabanidae species (Mullens, 2019), including other *Dasybasis* species, such as *D. pruinvitta* (González, 2004). Finally, Baqueanos had the largest clearing among sites (approximately 35 % larger than the other sites in average) where traps were placed. It is likely that trap increased visibility also contributed to the large number of captures. The marked influence of site location on tabanid abundance and species composition agrees with recent findings of research conducted in Uruguay (Lucaset al., 2020) where the environment was a determining factor related to the number of horseflies captures (largely represented by *Tabanus campestris* Brèthes, *T. aff. platensis* Brèthes and *D. missionum* (Macquart)).

In this study we documented a qualitative relation between horsefly abundance and average temperature. Although, monitoring populations over several years is needed to accurately evaluate the influence of weather variability on horsefly abundance, our observations provide preliminary information on this aspect. Weather events, such as the mean temperature drop by mid-late December suggest that low temperatures can negatively affect horsefly captures either by reducing insect activity or lowering local abundance due to higher mortality rates, as occurs with other Tabanidae species (Herczeget al., 2015). The rebound in captures two weeks later with higher temperatures, suggests new emergences and/or adults becoming active again after the cold period. The decrease in activity observed during mid-January is intriguing as is not associated to lower temperatures. This result suggests that additional factors, other than temperature and relative humidity fluctuations, may play a role in horsefly activity levels. Even though we only surveyed tabanid abundance and richness in five sites, some of them

with low captures, results suggest that differences in temperatures between sites seem to shift the moment when populations peak in their abundance (within our sampling period), with the site with the lowest temperatures being most abundant a few weeks later than the site with the higher temperature.

Tabanids are known to be vectors of several livestock diseases worldwide (Baldacchino et al., 2014). In Argentina they are known vectors of equine infectious anemia virus (EIAV) in areas adjacent to Patagonia to the north (Ricottiet al., 2016). Global change, through temperature rise and increased livestock transport can favor the spread of these diseases to northwestern Patagonia in the near future. Furthermore, although not quantified in the region, large densities of horseflies attacking cattle can result in losses in weight gain and reduction in milk production (Perichet al., 1986; Baldacchino et al., 2014). Therefore, data on species composition, relative abundance over time and species-habitat associations are much needed to face the likely expansion of diseases transmitted by horseflies to livestock in our study region. The current study is an initial contribution toward understanding spatiotemporal fluctuations in horsefly populations and activity in the Argentinean Patagonia.

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